SOME NOTES ON SOCIAL INTERACTIONS IN *POLISTES EXCLAMANS* (HYMENOPTERA: VESPIDAE)[1]

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ABSTRACT: The queen's dominance may be challenged by a worker-daughter. Social grooming, apparently related to moisture or other foreign substance, is present in this species.

DESCRIPTORS: Hymenoptera, Vespidae, *Polistes exclamans,* tail-wagging, grooming.

Haplometrotic nest founding is normal in *P. exclamans* Viereck, though pleometrotic founding is not unknown. (West Eberhard, 1969, and Hermann, Barron and Dalton, 1975). However, dominance conflicts may arise in mid-season and are signaled by changes in individual or colony-wide behavior. Dominance hierarchies have been observed in many *Polistes* species which normally found pleometrotically: *P. gallicus* Linnaeus (Pardi, 1948); *P. chinensis antennalis* Perez (Morimoto, 1961a, 1961b); *P. fadwigae* Dalla Torre (Yoshikawa, 1963); and *P. fuscatus* Fabricius, *P. canadensis* Linnaeus, *P. flavus* Cresson, and *P. annularis* Linnaeus (West Eberhard, 1969). Behavior which is part of the repertoire of dominance interactions in these species may have another function in *P. exclamans.*

MATERIALS AND METHODS

Two colonies were observed in New Jersey, about 20 miles east of Philadelphia, in 1973 and 1974. The observations, totalling about 200 hours, were made at irregular intervals, some being brief checks, others continuous for up to eight hours. The first nest was observed in its natural site. The second was transferred to a selected location. One observation of a third colony in 1975 is described below. All wasps were marked on the thorax or wing tips.

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DOMINANCE CONFLICT

Each colony had only one foundress; however, a second female joined the 1973 nest on June 12, a full month after its initiation on May 11. The buzzing foundress chased the larger newcomer around the nest for more than an hour, ceasing only after dark. The newcomer retreated, but refused to leave the nest. No further dominance interactions were observed; however, the foundress began to tail-wag the next day. The newcomer was less active than the foundress but did forage and share the work of extending cell walls and feeding larvae. She was never observed to tail-wag.

On July 4, six days after the first workers emerged, two cells were slightly damaged, two eggs were missing, and one of the workers was seen to pull out and malaxate a pupating larva, sharing it with another worker, and feeding the flesh to larvae. Two days later the wasp which had appeared on June 12 was found dying on the ground, having remained as co-foundress for more than three weeks, longer than any observed in this species over several years by Hermann, Barron, and Dalton (1975). Hermann and Dirks (1975) report the disappearance of subordinate co-foundresses coincident with the emergence of the first workers in *P. annularis*.

The foundress, unlike other queens observed, continued to forage after workers emerged, and she disappeared on July 28. A few days of disruption (missing eggs, destroyed pupae, reduced foraging and increased aggressiveness) followed her loss, before one of the first six workers to emerge assumed dominance, laying eggs and regularly shaking her abdomen, and colony activity returned to normal. The pattern of destructive behavior consistently appeared upon the loss of a queen, or a challenge to the dominant wasp. Fluno (1972) suggests that abdomen shaking (often referred to as tail-wagging) in *P. exclamans* may be a solicitation of grooming as is a similar behavior in honey bees, but he reports no observations of grooming. My observations as well as those of West Eberhard (1969) and of Hermann, Barron, and Dalton (1975) associate tail-wagging with dominance, but not with grooming.

The queen on the 1974 nest never foraged and, except for the challenge period described below, left the nest only briefly, settling a few feet away to defecate or to groom herself. Late in July she was challenged by one of the other three wasps on the nest when it was transferred on July 4. The challenger had foraged regularly and was almost certainly a daughter-worker. The queen had engaged in regular tail-wagging, and on July 25 the subsequent challenger began to tail-wag too. On July 27 the previously subordinate wasp was absent all day. About noon of the 28th, after buzzing was heard, the queen flew off, and the challenger was found on the nest. The queen returned, buzzing, and the challenger flew off. Later that day the tip of one of the queen's wings was seen to be slightly torn, and some time after that a falling fight with buzzing was observed between the challenger and an unidentified wasp, almost certainly the queen, from which the challenger emerged victorious, returning to the nest. The two wasps changed positions nine times that day, leaving the challenger on the nest overnight and the queen missing. The next day there were further alternations ending with the queen on the nest, and the challenger was not seen again.

A second instance of an apparent mid-season challenge on this nest involved a worker which had been absent for nine consecutive days when she returned on August 14. Two days after her return the queen was observed laying eggs in cells which had previously contained eggs, signaling the possibility of dominance conflict. That evening the returned wasp was observed resting on the ceiling above the nest, a position sometimes assumed by subordinate challengers in *P. canadensis* (West Eberhard, 1969). She crawled down onto the nest and apparently received fluid from a large larva once that evening and once the next morning, but was not observed to interact with any adult. At the next observation, after a 28-hour interval, she was absent, and she never reappeared, evidently having lost out in her interactions with the resident queen. Observations suggest that mid-season challenges by daughter workers may be common in this species, perhaps thus assuring unfertilized eggs to provide the necessary male population late in the season.

SOCIAL GROOMING

Until very recently social grooming was unknown in social wasps. It has been reported in *Protopolybia* (Naumann, 1970) and in *Metapolybia* and *Parachartergus* (West Ebergard, personal communication). This behavior was observed in both these *P. exclamans* colonies and in a third observed in 1975. Seven of nine individual instances seen in 1973 were clearly attempts to remove the water-based paint markings. Six attempts to remove markings (model airplane paint) were observed in 1974, but four included biting or snapping and have been excluded from the count of 43 instances of non-aggressive grooming in the 1974 colony. Grooming not directed at painted areas was most frequently focused behind the head, between head and thorax. This behavior differs from dominance behavior in that two wasps sometimes collaborate in grooming a third and the grooming wasps never become increasingly aggressive as is common in the grooming-like chewing accompanying dominant behavior.

An hypothesis concerning the function of this behavior can be derived from two sets of observations. The first concerns the circumstances preceding two instances of general, colony-wide social grooming. In the first case a windstorm with heavy rain had drenched the 1973 nest and its occupants. The wasps removed water from each other, as well as from the nest surface, hanging head downward from the nest and dropping the water on the ground. The second case involved a well-developed colony in southern New Jersey which was transferred with all its occupants on a hot, humid, late-August evening in 1975. The wasps were partially anaesthetized by CO_2 and placed in a refrigerator while the nest was being attached in a plexiglas and screen "cage." When the wasps were placed in the cage and began to move about, virtually all became engaged in removing condensation from one another. In both cases the behavior, identical to the behavior in the individual instances of social grooming, was unquestionably devoted to removing moisture.

The second set of observations concerns the relation of grooming in the 1974 nest to the history of one particular wasp. This wasp, emerging on August 3, was inadvertently left under a glass from August 5 to August 10. The glass became thickly clouded with condensation on the inside, and the wasp was very feeble and wet when returned to the nest. She was attacked vigorously by three of her nest mates, though she antennated with another and was ignored by the rest. She was driven from the nest and did not return until the next day, When she was again briefly attacked but less vigorously by one of the same three, though ignored by the others. No further attacks by these three were seen but she was later groomed on two occasions by other wasps, once by two wasps together. The 43 grooming instances include 16 involving this wasp directly or indirectly: three instances of wasps grooming her and 12 instances in which the groomee had previously attacked, groomed, or antennated with her soon after her return to the nest.

Taken together with the instances of colony-wide grooming, these observations suggest that grooming is stimulated by the presence of moisture and perhaps also by other substances which pose a hazard and which may pass as contaminants from one wasp to another. This behavior, elicited by stimuli which threaten colony success, may be a forerunner of the dominance behavior observed in other species.

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